International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.5., 2015
(Sept.-Oct.)

RESEARCH ARTICLE

ISSN: 2321-7758

REDUCTION OF REWORKS AND REJECTIONS IN MANUFACTURING OF A THIN WALLED AEROSPACE COMPONENT

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ABSTRACT

Machining of thin-walled components has increasingly become a difficulty for manufacturers. Advanced digital analyses have been developed by many researchers to model, predict and reduce errors induced by machining processes. Moreover, today's machining shop floors, characterized by a large variety of products in small batch sizes, require flexible simulation tools that can be quickly reconfigured. CAD/CAM systems play a vital role in design optimization and process optimization of any component and helpful in reducing the rejections and reworks.

The dynamic characteristics analysis of missile shield is mainly involved in the calculation about vibrations on model. The objective to calculate the vibrations and resonances of missile shield is modulating those frequencies and avoiding resonance, thus the vibrations of missile shield may reduce.

The thin wall component taken for this project is a missile shield. The missile shield protects the missile by covering the entire body. The missile shield design and process planning are studied in detail. This project also deals with development of manufacturing process plan of missile component (missile shield) using CAM software (NX 7.5) which is exclusively CAM software used to generate part program by feeding the geometry of the component and defining the proper tool path and thus transferring the generated part program to the required CNC machine with the help of DNC lines. Keeping in view the above important aspect this project has been taken up for reducing the rejections to a minimum. The aim of the project is to reduce rejection rate rework rate.

In this project, the 3d model of missile shield is designed in UNIGRAPHICS software and it is imported to ANSYS software to perform the dynamic analysis. In this project efforts are made to produce different process plans in CAM software by changing the work holding systems, tool paths, cutting tools etc. Finally, recommending an optimum process plan for manufacturing of the component.

Keywords: Design, Analysis, Manufacturing, Missile shield Aerospace component, Missile.

1.0 INTRODUCTION

1.1 ABOUT THE COMPONENT [1]: A missile is a self-propelled guided weapon system. Missiles have four system components: targeting and/or guidance, flight system, engine, and warhead. Missiles come in types adapted for different purposes: surface-to-surface and air-to-surface (ballistic, cruise, anti-ship, anti-tank), surface-to-air (anti-aircraft and anti-ballistic),

air-to-air, and anti-satellite missiles. The missile shield protects the missile by covering the entire body. The missile shield design and process planning are studied in detail.

1.2 UNIGRAPHICS INTRODUCTION [1-3]: NX is one of the world's most advanced and tightly integrated CAD/CAM/CAE product development solutions. Spanning the entire range of product development, NX delivers immense value to enterprises of all sizes. It simplifies complex product designs, thus speeding up the process of introducing products to the market.

The NX software integrates knowledge-based principles, industrial design, geometric modeling, advanced analysis, graphic simulation, and concurrent engineering. The software has powerful hybrid modeling capabilities by integrating constraint-based feature modeling and explicit geometric modeling. In addition to modeling standard geometry parts, it allows the user to design complex free-form shapes such as airfoils and manifolds. It also merges solid and surface modeling techniques into one powerful tool set. Our previous efforts to prepare the NX self-guiding tutorial were funded by the National Science Foundation's Advanced Technological Education Program and by the Partners of the Advancement of Collaborative Engineering Education (PACE) program

2.0 Development of 3d model

3D model is designed by using NX cad software.

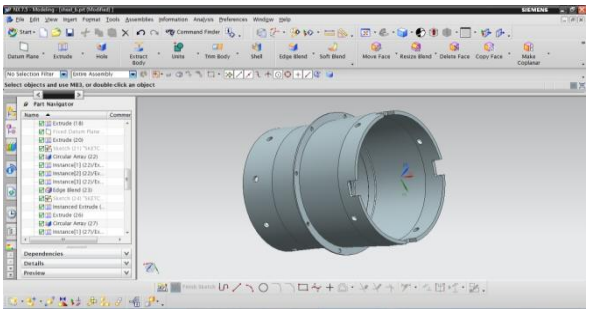

Fig 1: Final 3D model of missile shield

3.0 RSA analysis along X- direction

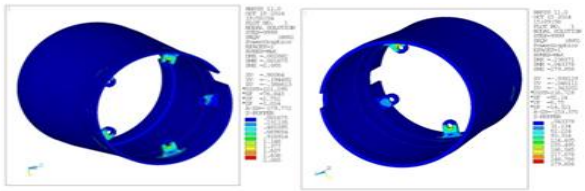

Fig 2. VonMises Stress of missile shield for RSA analysis in X-Dir

4.0 RSA analysis along X- direction

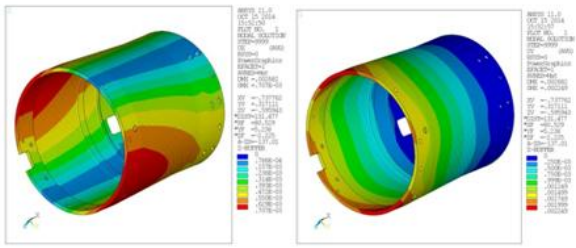

Fig3. Deflections in X - Direction of missile shield for RSA analysis in X-Dir

5.0 Deflection and VonMises stress of missile shield for RSA analysis in X-Dir

S.NO.	DEFLECTION(mm)	VONMISES STRESS (MPa)
1	0.0026	2.06

6.0 COMPUTER AIDED MANUFACTURING [2-3]

Computer-aided manufacturing (CAM) is the use of computer software to control machine tools and related machinery in the manufacturing of work pieces. This is not the only definition for CAM, but it is the most common; CAM may also refer to the use of a computer to assist in all operations of a manufacturing plant, including planning, management, transportation and storage. Its primary purpose is to create a faster production process and components and tooling with more precise dimensions and material consistency, which in some cases, uses only the required amount of raw material (thus minimizing waste), while simultaneously reducing energy consumption.

CAM is a subsequent computer-aided process after computer-aided design (CAD) and sometimes computer-aided engineering (CAE), as the model generated in CAD and verified in CAE can be input into CAM software, which then controls the machine tool.

CAM on missile shield

Maintaining stable speed missile shield component is manufactured on CNC machine. The main objective of the project is to reduce rejection and reworks rate. Methodology used in manufacturing of missile shield is as mentioned below:

- Identifying suitable machine.
- Selecting suitable tools for manufacturing thin walled component.

- Designing fixture/mandrel to missile shield component for external operations.
- Listing down the Sequence of operations performed on missile shield component.
- Generating tool path at specified cutting speed.
- Generating NC program using NX-CAM software.
- Sequence of operations performed on missile shield component

7.0 SEQUENCE OF OPERATIONS PERFORMED ON MISSILE SHIELDCOMPONENT

Sequence of operations performed on missile shield in NX-CAM software are listed below

Set up-1
Facing operation
OD_Rough_Turn operation
ID_Rough_Bore operation
Set up-2
Facing operation
OD_Rough_Turn operation
Finally Drilling operation

8.0 REDUCTION OF REJECTION RATE AND REWORKS RATE [2-4]

Reducing rejection rate and reworks rate using 5-why (or) why-why analysis which helps in increasing production rate of industry

5-why analysis (or) why-why analysis

- It is a method of questioning that leads to the identification of the root cause(s) of a problem.
- A why-why is conducted to identify solutions to a problem that address it's root cause(s). Rather than taking actions that are merely band-aids, a why-why helps to identify how to really prevent the issue from happening again.
- A why-why is most effective in a team setting or with more than one person involved. Capture the input on a flipchart or a simple spreadsheet like the one below.
  - First start with the problem like to solve. Then ask, "Why is x taking place?" You will end up with a number of answers. Jot these down.
  - Repeat the process for each of the answers to the first question.
  - Repeat the process for each of the answers to the second 'why' and continue until you've asked why 5 times.
  - When you've hit the 5th why, you usually have determined some root causes. Now you can identify specific action plans to address those root causes.
- Involve the right people – it helps to have those that are familiar with the process and the problem in the room so they are able to answer why something happened. It is also helpful to have someone with a fresh eye participate – often they ask questions that help those involved in the problem extract the real reasons something happened.
- Avoid blaming – look for systemic problems. You are looking for systematic solutions to the problem. Blaming an individual ends up only making people feel bad.

9.0 Main Causes of Rejection Rate in industries

- Operator's negligence at work place and their poor knowledge in manufacturing.
- Rejection rate also increased due to equipment such as component setup, assigning improper tools, fixture design problems.
- Another cause of increase in rejection rate is due to procedure of machining like mistakes in sequence of operations (Turning, Milling and Drilling).
- Another cause is following the norms or rules of the company in impossible conditions of machining the component.

10. Solution obtained to reduce rejection and reworks:

- To reduce rejection rate the thin walled component is manufactured in a sequence as first internal operations and next by using mandrel support external operations are done.
- Proper tools are specified which will support for machining thin walled component.
- Redesign of mandrel is done to reach high surface finish without fail.
- By considering 2D inputs 3D model is generated using NX-CAD software.

11. RESULTS

The missile shield was studied for 2 different cases:

- Modal analysis
- Spectrum Analysis
- RSA analysis

MODAL ANALYSIS:

From the above modal analysis results it is observed that only 5 natural frequencies exists in the operating range of 0-500 Hz.

From the modal analysis,

The total weight of the missile shield is 0.005Tone.

- It is observed that the maximum mass participation of 0.0002Tone in Y-dir for the frequency of 926Hz.
- It is observed that the maximum mass participation of 0.0002Tone in Y-dir for the frequency of 941Hz.

However RSA analysis has been carried out to check the structure behavior for random vibrations in the frequency range of 0-1000Hz.

RSA ANALYSIS

From the RSA analysis in X - Dir [5]

Table.2 Deflection and VonMises stress of missile shield for RSA analysis in X-Dir

S.NO.	DEFLECTION(mm)	VONMISES STRESS (MPa)
1	0.0023	2.06

From the RSA analysis in Y - Dir,

Table.3 deflection and VonMises stress of missile shield for RSA analysis in Y-Dir

S.NO.	DEFLECTION(mm)	VONMISES STRESS (MPa)
1	0.23	279

From the RSA analysis in Z - Dir,

Table.4 deflection and stress of missile shield for RSA analysis in Z-Dir

S.NO.	DEFLECTION(mm)	VONMISES STRESS (MPa)
1	0.47	402

From the above RSA results observed VonMises stress 2MPa, 279MPa and 402MPa are less than the yield strength of material used for missile shield. The yield strength of the material used for missile shield is 420MPa.

According to the VonMises Stress Theory, the VonMises stress of missile shield is less than the yield strength of the material.

CAM RESULTS: Results are represented graphically to specify the quality control of missile shield component

Graphical representation of rejection and reworks rate

Below graphs shows the rejection and reworks rate before WHY-WHY analysis and after WHY-WHY analysis[6].

Results before WHY-WHY analysis

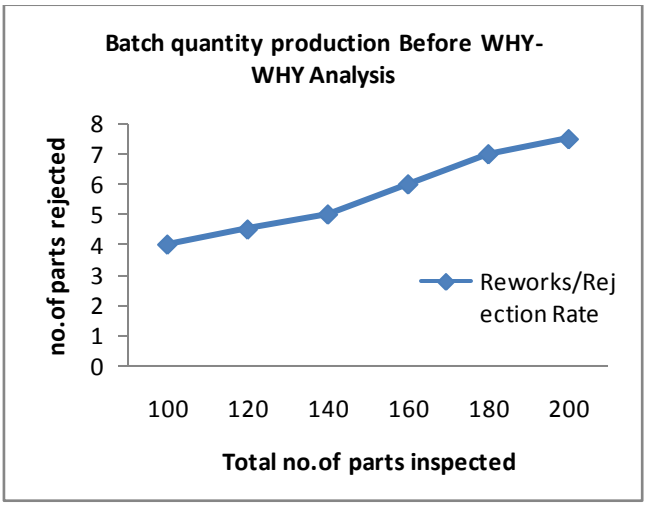

Fig.4. Graph of rejection and reworks rate before WHY-WHY analysis

Results after WHY-WHY Analysis

These four causes for rejection which are mentioned above is rectified by using WHY-WHY Analysis. The following graph indicates rejection rate after WHY-WHY Analysis.

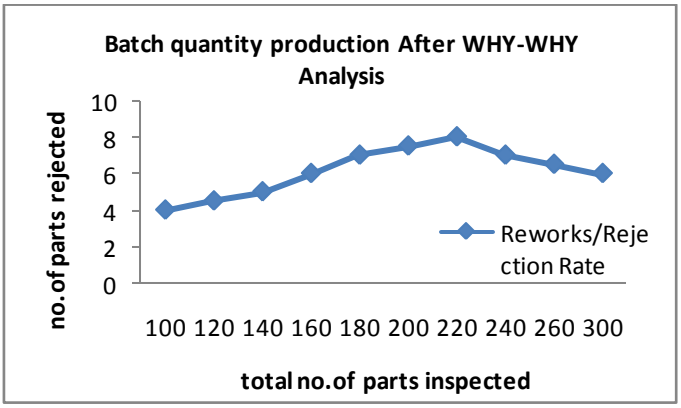

Fig.5. Graph of rejection and reworks rate after WHY-WHY analysis

From the above result graphs it is concluded that the reworks and rejection rate is decreased from 9% to 6% after using WHY-WHY Analysis.

CONCLUSION

In the present project the missile shield has been designed and analyzed for Dynamic behavior and Tool path is generated.

From the above analysis it is concluded that that the missile shield has stresses and deflections within the design limits of the material used. The deflections and stresses obtained in the spectrum analysis are also under the design limits of the material.

Therefore it concluded that the missile shield is safe under the random loading conditions.

- Tool path is generated on missile shield using NX_CAM software.
- The thin walled (missile shield) component is manufactured in a sequence as first internal operations and next by using mandrel support external operations are done to reduce rejection rate.
- Proper tools are specified which will support for machining thin walled component.
- By WHY-WHY analysis is done to check rejection and rework rate is reduce or not.
- Graphical representation of rejection and reworks rate before and after WHY-WHY analysis is shown in results.

REFERNCES:

[1]. http://www-cad.fnal.gov/UG-NX5_tutorial.pdf
[2]. http://web.mst.edu/~mleu/NX9.0%20Manual.pdf
[3]. http://web.mst.edu/~mleu/UG-NX3-Tutorial.pdf
[4]. http://www2.apwa.net/documents/About/Coop Agreements/EMS/What%20is%20a%20why.doc
[5]. http://nukoe.com/nukoe-blog/what-is-a-why-why-analysis/
[6]. http://wenku.baidu.com/view/181b8a160b4e767f5acfce52.html